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FOR

PROTECTIVE LAYER DURING SCRIBING

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PROTECTIVE LAYER DURING SCRIBING

BACKGROUND

FIELD

[0001] Circuit fabrication.

BACKGROUND

[0002] The scribe process is used to scribe a circuit substrate (e.g., wafer) prior to sawing the substrate into individual chip or die. According to current technology, a scribe process often uses an ultraviolet laser (typically a yttrium aluminum garnet (YAG) laser) to scribe the substrate prior to a sawing operation. By scribing the substrate prior to sawing, a saw process that saws or cuts through the scribe area to divide or singulate the substrate can generally do so without damaging films (typically dielectric films) on the substrate. During a scribe process, the scribe is created in designated areas or streets by ablating any metal layers or dielectric layers (e.g., low dielectric constant dielectric layers) to the substrate (e.g., a silicon substrate). A laser scribe process typically generates ablated material (mostly silicon with some carbon) as debris. This debris tends to fall on the surface of the substrate. The surface of a substrate generally has a number of exposed contacts (e.g., bump contacts) on its surface. Thus, the debris tends to fall on the contacts and can adhere to the contact surface. This contamination of the contact surface inhibits the contacts from joining subsequent contacts during packaging leading to a characterization referred to as non-wet defects.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] Features, aspects, and advantages of embodiments will become more thoroughly apparent from the following detailed description, appended claims, and accompanying drawings in which:

[0004] **Figure 1** shows a top side view of a portion of a wafer having a number of discrete circuit structures formed thereon separated by scribe streets.

[0005] **Figure 2** shows a cross-sectional side portion of the structure of **Figure 1** through line A-A'.

[0006] **Figure 3A** shows the structure of **Figure 2** following the introduction of a chemically soluble coating on a surface of the structure according to one embodiment.

[0007] **Figure 3B** shows the structure of **Figure 2** following the introduction of a chemically soluble coating on a surface of the structure according to another embodiment.

[0008] **Figure 4** shows the structure of **Figure 3A** and a scribe process.

[0009] **Figure 5** shows the structure of **Figure 4** during a wet sawing process.

[0010] **Figure 6** shows the structure of **Figure 5** following the wet sawing process.

[0011] **Figure 7** shows a side view of a die or chip connected to a package.

DETAILED DESCRIPTION

[0012] **Figure 1** is a schematic top side view of a portion of a substrate such as a wafer with number of discrete circuit structures formed therein and thereon. **Figure 2** is a cross-sectional side view of the structure of **Figure 1** through line A-A'. Referring to **Figure 1** and **Figure 2**, structure 100 includes substrate 105 of, for example, a semiconductor material such as silicon or a semiconductor layer on an insulator such as glass. Structure 100 is a portion of a structure at a wafer level with a number of circuit structures (dies or chips) discreetly represented and connected at this point. Each circuit structure (e.g., die or chip 110A, . . . 110I) is separated on substrate 105 by scribe streets 120 that are used as a singulation area to separate the circuit structures from the substrate into a discrete die or chip. **Figure 1** shows dies or chips 110A,

110B, 110C, 110D, 110E, 110F, 110G, 110H, and 110I (see **Figure 1**). Each circuit structure (e.g., die or chip 110A, . . . 110I) may have a number of circuit devices formed in and on substrate 105 and one or more interconnection layers formed above substrate 105 and connecting with the devices on a respective die or chip. A top surface of each circuit structure may have a number of contact points including, in this example, solder or similar conductive material bumps to send or receive signals external to the die or chip. Bumps 115 protrude from a surface of a respective die or chip and, as viewed in **Figure 2**, are exposed on the surface of the respective die or chip. As shown in **Figure 2**, each bump protrudes from a surface of the substrate, a height, T_1 of, on the order of 75 microns. Each bump 115 may be surrounded by a dielectric material that otherwise covers the surface of substrate 100.

[0013] **Figure 3A** shows the structure of **Figure 2** following the introduction of a chemically soluble coating on a surface of structure 100. Chemically soluble coating 130 is deposited, in one embodiment, to a thickness, T_2, that is greater than a height, T_1, of protrusion of bumps 115 from a surface of the substrate. In this manner, chemically soluble coating 130 overlies (as viewed) bumps 115. In another embodiment, shown in **Figure** 3B, chemically soluble coating 130 is deposited as a relatively conformal coating, conforming to the surface of structure 100 and overlying bumps 115. A representative thickness of chemically soluble coating 130 is on the order of five to 35 microns (μm) and, in this embodiment, is thick enough to overly bumps 115 but not too thick that chemically soluble coating 130 may be not be subsequently removed in a reasonable time. Chemically soluble coating 130, as viewed, overlies each circuit structure of structure 110 as well as scribe streets 120.

[0014] In one embodiment, a material of chemically soluble coating 130 is a material that may be subsequently removed from the substrate surface. Where an ultraviolet laser scribe process will be used to scribe structure 100, a material for chemically soluble coating 130 should also be transparent to ultraviolet light so that it does not inhibit a subsequent scribe process (e.g., a YAG laser scribe process). Finally, in one embodiment, a material for chemically soluble coating 130 is environmentally non-toxic or harmful so that additional cautionary measures need not be taken during removal. Suitable materials for chemically soluble coating 130 include organic coatings, including hydrophillic coatings, such as methyl cellulose, polyvinyl alcohol,

and resin flux. These materials are transparent to ultraviolet light, may be removed with water, and are environmentally non-toxic or harmful. In one embodiment, chemically soluble coating 130 of a material such as methyl cellulose, polyvinyl alcohol, or resin flux may be applied to the substrate surface by various coating techniques, including, but not limited to, spinning, electrostatic spraying, or other techniques.

[0015] **Figure 4** shows the structure of **Figure 3A** and illustrates a scribe process in scribe streets 120. In one embodiment, a laser scribe process is utilized in which a YAG laser is used to scribe substrate 105. The scribing process tends to generate debris, mostly silicon and carbon, that, as the substrate is ablated, falls on chemically soluble coating 130.

[0016] **Figure 5** shows the structure of **Figure 4** and illustrates a sawing process. In one embodiment, the sawing process utilizes saw 140 and water 145 (a wet sawing process). Saw 140 cuts through substrate 105 to singulate circuit structures (e.g., dies or chips 110A, . . . 110I). Where chemically soluble coating is water soluble, in one embodiment, the water utilized during the sawing process may serve also to remove the material of chemically soluble coating 130. Alternatively, chemically soluble coating 130 may be removed, such as by rinsing with water or other solvent, prior to or after the sawing process.

[0017] **Figure 6** shows the structure of **Figure 5** following the singulation of individual circuit structures. Illustrated in **Figure 6** are die or chip 110A, die or chip 110B, and die or chip 110C. **Figure 6** also shows each circuit structure after the removal of chemically soluble coating 130. In this manner, contacts (bumps) 115 are exposed. Any debris that was generated process, during the scribing process, has been removed with the removal of chemical soluble coating 130.

[0018] **Figure 7** shows die or chip 110A mounted on package 150. In this embodiment, the mounting method includes contacting bumps 115 of die or chip 110A with corresponding contact points or bumps 155 of package 150. Once the contact between the contact points is made, a reflow process may be used to join die or chip 110A to package 150. By utilizing chemically soluble coating 130 during the scribing process, the ability of ablated material to land on contact points or bumps 115 is

minimized. Accordingly, the possibility of defects occurring when a die or chip is connected, for example, to a package, is minimized (e.g., the number of non-wets is minimized).

[0019] In the preceding paragraphs, specific embodiments are described. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of the claims. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.